

Draft Environmental Assessment
for
Propagate and Restore Endangered Mussels in the Green River
PMIS Number 81947

INTRODUCTION

Approximately 35% of North America's mussel fauna are known from Kentucky making it the third most diverse assemblage in North America (Cicerello et al. 1991). Nearly half of Kentucky's mussel species are found within the Upper Green River Drainage, which includes Mammoth Cave National Park, and some species are imperiled due to reduced survival of juvenile mussels (Stansbury 1965, Isom 1974, Cicerello et al. 1991, Layzer et al. 2001). While historical records indicate 72 mussel species once occurred in the Upper Green River, a 1999 survey showed mussel diversity had declined 26% to 53 species (Cicerello and Hannan 1990, Cicerello et al. 1991, Cicerello 1999). The reach of the Green River within Mammoth Cave National Park is inhabited by seven mussel species federally listed as endangered (i.e., *Obovaria retusa*, *Pleurobema plenum*, *Pleurobema clava*, *Epioblasma torulosa biloba*, *Epioblasma obliquata obliquata*, *Cyprogenia stegaria*, and *Hemistena lata*). The U.S. Fish and Wildlife Service has identified seven additional species as candidates for listing as threatened or endangered. Another six species have been assigned a conservation status by the Kentucky State Nature Preserve Commission.

For rarer species, the populations in the Green River are the best remaining occurrences (i.e., fanshell (*Cyprogenia stegaria*) and ring pink (*Obovaria retusa*)). In fact, the Green River may contain the last remaining population of *Obovaria retusa* in the world.

The purpose of this project is to restore freshwater mussel biodiversity and ecological function to the free-flowing reach of the Green River within Mammoth Cave National Park and to further the recovery of federally endangered mussels. The goals of this project are to maintain existing populations, restore viable populations to their former historic range, and ultimately to remove the species from the federal endangered species list. The National Park Service has signed an agreement to cooperate with the U.S. Fish and Wildlife Service to pursue conservation actions.

DESCRIPTION OF THE PROPOSED ACTION

With the assistance of numerous partners (i.e., Tennessee Technological University, United States Fish and Wildlife Service, Kentucky Department of Fish and Wildlife Resources and the United States Army Corps of Engineers) Mammoth Cave National Park has obtained funding to establish a mussel culture facility to be located on the Green River. The facility would be located inside an office trailer shell. The facility would utilize water from the Green River to culture juvenile mussels of the seven federally listed species and house their brood stock. Rearing juvenile mussels using water from their native stream is preferred over the use of treated municipal water. At first, juveniles from common mussel species (e.g., *Actinonaias ligamentina*) would be used to refine husbandry techniques in the facility. Eventually, remaining federally listed mussel species would be collected and their reproduction managed within a laboratory at

Tennessee Technological University. Captive-bred juveniles would be transported to the Mammoth Cave National Park facility, cultured using Green River water and substrate, and then seeded back into the Green River in sufficient numbers to foster a self-sustaining population.

Restoration of mussel fauna in the vicinity of Mammoth Cave National Park is a critical component of the strategy to conserve mussel fauna in the southeastern United States. The cooperating agencies chose Mammoth Cave National Park for this initiative for the following reasons.

- The National Park Service is committed to the conservation and restoration of native biodiversity on lands it manages.
- The Green River drainage supports the third most diverse mussel assemblage in Kentucky.
- The discovery of juvenile mussels suggests some species are healthy.
- Fish populations are improving.
- Some species extirpated from Mammoth Cave National Park still exist at other locations in the Green River system and are available for reintroduction.

Through this proposed recovery effort, the National Park Service can: meet the goal of the 1916 National Park Service Organic Act "...to conserve the scenery and the natural and historic objects and wildlife therein..." The proposal would fulfill the objective of National Park Service management policies to manage mussel populations because "The species disappeared, or was substantially diminished, as a direct or indirect result of human-induced change to the species population or the ecosystem." (Section 4.4.2.2 National Park Service Management Policies 2001). The proposal would also satisfy the requirements of section 7(a) of the Endangered Species Act for Federal agencies to carry out programs to conserve endangered and threatened species.

DECISIONS TO BE MADE

There are two decisions to be made. The first decision is a choice between no action and initiation of an endangered mussel culture project. If the first choice is made in favor of initiation of a mussel culture project, then the second decision is a choice between alternative locations for the propagation facility.

BACKGROUND

The mussel conservation proposal is consistent with National Park Service Management Policies (2001) to restore extirpated native species and recover all endangered species that belong in a park unit. Section 4.4.2.3 in Management Policies 2001 states in part that the National Park Service would "Undertake active management programs to monitor, restore and maintain listed species...and the habitats upon which they depend." Further, these actions support the Mammoth Cave National Park mission, which was established by specific enabling legislation.¹ The mission includes the text of the legislative acts as well as related reports and speeches that

¹ 16 U.S.C. 404-404f.

were prepared in support of the legislation. Following is a selection of excerpts from the legislative record that specifically relate to resource values.

Your commission has also made a careful examination of the Mammoth Cave region of Kentucky and believes sufficient reasons exist to warrant its acceptance as a national park if requirements are met as outlined in this report. Below are briefly outlined some of these reasons. Mammoth Cave is the best known and probably the largest of a remarkable group of limestone caverns, 20 or more of which have been opened up and explored to a greater or less extent. There is good evidence that many more caverns yet to be discovered exist in this immediate territory, and it seems likely that most, if not all, of this entire group of caverns eventually would be found to be connected by passageways forming a great underground labyrinth of remarkable geological and recreational interest, perhaps unparalleled elsewhere. The Mammoth Cave area is situated in one of the most rugged portions of the great Mississippi Valley and contains areas of apparently original forests, which, though comparatively small in extent, are of prime value from an ecological and scientific standpoint and should be preserved for all time in their virgin state for study and enjoyment. Much of the proposed area is now clothed in forest, through which flows the beautiful and navigable Green River and its branch, the Nolin River. All this offers exceptional opportunity for developing a great national recreation park of outstanding service in the very heart of our Nation's densest population and at a time when the need is increasingly urgent and most inadequately provided for.²

The connection between the report of the Southern Appalachian National Park Commission, the purpose of the proposed park, and the legislation that established Mammoth Cave National Park is clear in the speech by Congressman Thatcher, when he said,

The bill now under consideration (H.R. 12020) is drafted in strict accordance with the recommendations of the aforesaid commission.³

The area called for in the bill would insure a great recreational ground, most advantageously located, where, in spring, summer, and fall thousands of our people may find—in addition to the pleasure and interest derived from an inspection of the caves and their many features of interest—the most delightful outdoor recreation in boating and fishing on Green and Nolin Rivers, lovely, navigable streams flowing for miles through the proposed park, and in traversing the picturesque and rugged hills and valleys and great forests of the region included in the proposed park area.⁴

MISSION STATEMENTS

The following mission statements were created as broad statements of the mission requirements established by Congress in the Acts that created the National Park Service and Mammoth Cave National Park.

² United States Department of the Interior, Final Report of the Southern Appalachian National park Commission to the Secretary of the Interior, June 30, 1931 (GPO: Washington D.C., 1931) 18.

³ Mammoth Cave National Park, Speech of Hon. Maurice H. Thatcher in the House of Representatives, March 5, 1930 (GPO: Washington, D.C., 1930) 8.

⁴ Speech of Hon. Maurice H. Thatcher, 11. The same language appears in the Senate, Committee on Public Lands and Surveys, Report No. 823, May 10, 1926, and the House of Representatives, Committee on the Public Lands, Report No. 1178, May 12, 1926.

National Park Service Mission

The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration, of this and future generations. The Service cooperates with partners to extend the benefits of natural and cultural resources conservation and outdoor recreation throughout this country and the world.⁵

Mammoth Cave National Park Mission

The mission of Mammoth Cave National Park is to protect and preserve for the future the extensive limestone caverns and associated karst topography, scenic riverways, original forests, and other biological resources, evidence of past and contemporary lifeways; to provide for public education and enrichment through scientific study; and to provide for development and sustainable use of recreation resources and opportunities.⁶

MANAGEMENT OBJECTIVES IN THE GENERAL MANAGEMENT PLAN RELATED TO THIS PROJECT

To minimize impacts on fragile natural resources by locating facilities in areas that are able to support such use without sustaining unacceptable environmental damage.

⁵ United States Department of the Interior, National Park Service, GPRA on the GO: Government Performance and Results Act (GPRA) & Performance Management, Version 2.2, May 1998.

⁶ Mammoth Cave National Park, Strategic Plan, 3.

ALTERNATIVES

ALTERNATIVES CONSIDERED

Alternative A: No Action

Alternative B: Propagate Endangered Mussels

Sub-alternative B1: River Styx Site

Sub-alternative B2: Green River Ferry Site (North side)

Sub-alternative B3: The Western Kentucky University Site

DESCRIPTION OF ALTERNATIVES

Alternative A: No Action.

Existing programs have not been effective in protecting mussels and mussel habitat the upper reaches of the Green River. There is some expectation that the conservation efforts undertaken in recent years will produce some benefits for water quality and mussel populations in the Green River it should not be expected that any major positive changes would occur. The no action alternative would be accomplished through continuation of the existing programs to improve water and other habitat quality parameters in the Green River within Mammoth Cave National Park. Mammoth Cave National Park would continue to comply with laws and regulations aimed at conserving and enhancing habitat quality in the Green River within Mammoth Cave National Park. The no action alternative would help ensure the survival of existing populations of federally listed and non-listed mussels in the Green River within Mammoth Cave National Park. The no action alternative would result in some increased density of the less critically imperiled rare mussel (i.e., *C. stegaria*) at shoals in the Green River within Mammoth Cave National Park. The no action alternative would also produce a minor increase in the range of existing less critically imperiled rare mussels in the Green River within Mammoth Cave National Park. It is unlikely that continuation of current actions alone will be sufficient to halt the decline of mussel populations in the Green River.

Alternative B: Propagate Endangered Mussels

The continued decline of mussel populations dictates the need for an active intervention strategy. The no action alternative described above is expected to improve water quality in the Green River to some extent. However, whether improved water quality alone would be sufficient to halt the decline of mussels is unknown. It is also unknown if the projected improvement would occur before some mussels become extinct.

There has been considerable success in reproducing mussels up to the point they become juveniles. Raising juveniles has not been successful when treated municipal water is circulated through the trays and tanks. Facilities that extract water directly from the home waters of the species have been successful. The proposed facility would be located inside an office trailer shell. The facility would use water from the Green River to culture juvenile mussels of the six federally listed species and house their brood stock. This method is proposed, due to increased survival rates of juvenile mussels cultured in their native water, over those cultured using treated

municipal water. At first, juveniles from common mussel species (e.g., *Actinonaias ligamentina*) would be used to refine husbandry techniques in the facility. Eventually, remaining federally listed mussel species would be collected and their reproduction managed within a laboratory at Tennessee Technological University. Captive-bred juveniles would be transported to the Mammoth Cave National Park facility, cultured using Green River water and substrate, and then seeded back into the Green River in sufficient numbers to foster a self-sustaining population

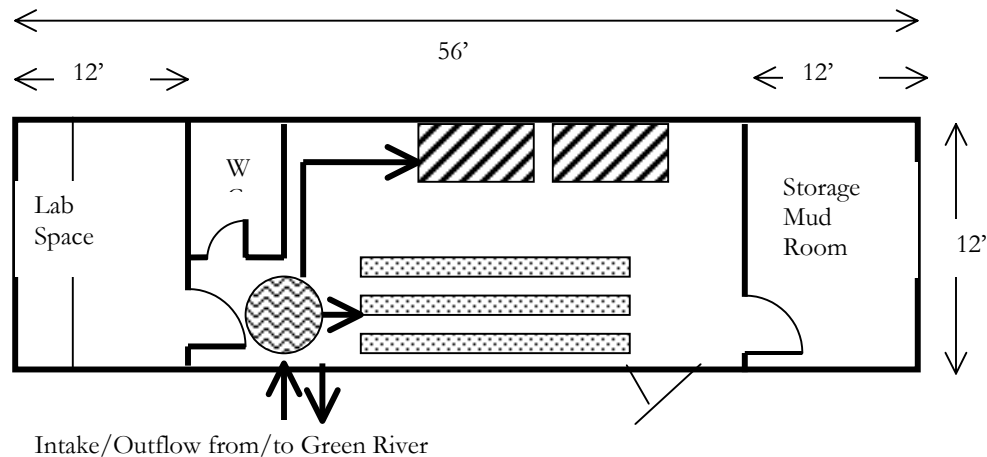


Figure 1. Idealized floor plan for a semi-mobile office trailer outfitted as a mussel culture facility. The rectangular boxes are brood stock tanks, the oblong boxes are mussel culturing trays, and the circle is a head tank to hold Green River water. Arrows indicate direction of water flow from head tank.

A semi-mobile facility is preferred over a permanent one since it can be moved in case of a catastrophic flood. An office trailer would be purchased and set in place at the alternative that is chosen. Ground disturbance for installation of the trailer is expected to be minimal. Mammoth Cave National Park would be responsible for purchase and installation of the trailer as well as outfitting it with appropriate equipment. The park would maintain the propagation facility throughout the life of the project. The project would be supervised by Dr. Jim Layzer, U.S. Geological Survey, Biological Research Division, stationed at Tennessee Technological University. Dr. Layzer holds a valid permit from the U.S. Fish and Wildlife Service for operation of a mussel propagation facility which includes propagation of the Federal endangered species found in the Green River. Dr. Layzer also holds a valid research and collection permit for the portion of the work that would be accomplished in Mammoth Cave National Park.

The former site of the park sewage treatment facility is the location of Sub-Alternative B1. The sewage treatment facilities were removed in the early 1990's. Reopening the sewer plant access road, which is currently used as a hiking trail, would provide site access. The major disadvantage of this site is the lack of utilities. Electric and telephone lines slightly over one half mile in length would have to be constructed. Only the upper portion of the site is above the 100-year floodplain. The proximity to hiking trails also increases the threat of vandalism. The strongest argument for locating the mussel culture facility in this location is its potential for public

outreach. There are two well-traveled hiking trails in the area. Locating the mussel culture facility there would permit the public to get an idea of the importance of this and other mussel culture projects.

Sub-Alternative B1. River Styx Site (See Figure 2 below)

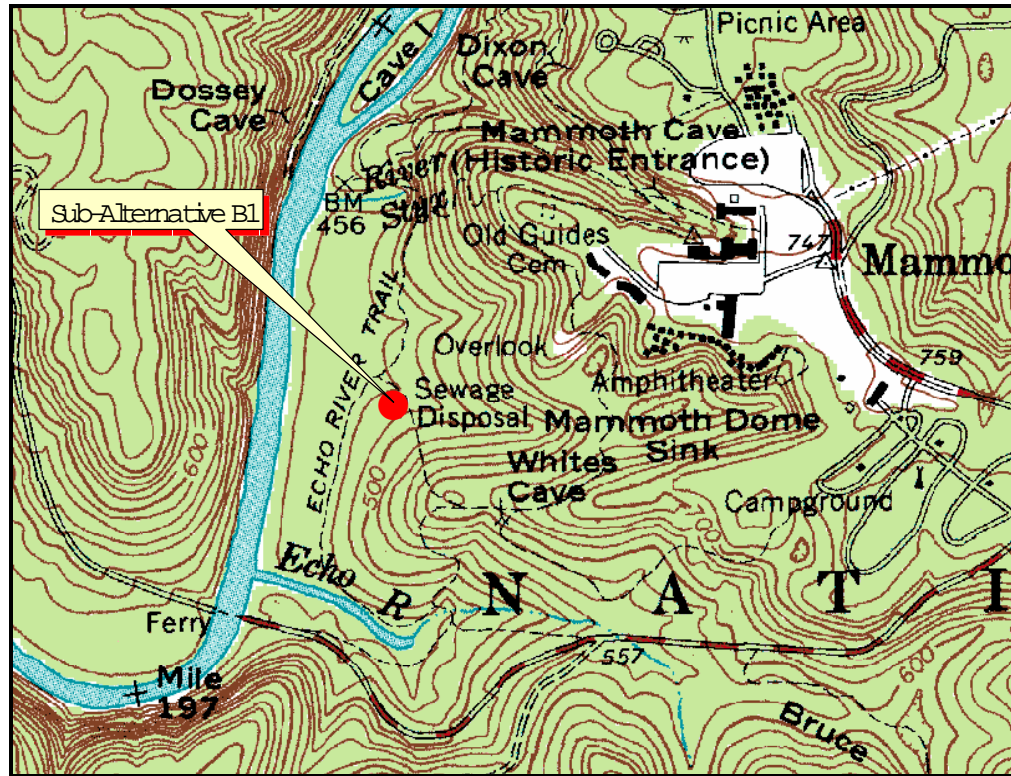


Figure 2. Location of site alternative B1 for mussel culture facility. The red dot indicates the potential site.

Sub-Alternative B2. Green River Ferry Site (See Figure 3 below)

This alternative location would place the mussel culture facility adjacent to the road on the North side of the Green River at the Green River Ferry Site. This is a very attractive site because it is close to the Green River and high enough to be out of the 100-year floodplain. This location would be very visible to the public. Approximately 130,000 vehicles cross the ferry annually. Although there is currently electric power available at this site, it is scheduled to be removed in 2003. Retention of the electric service would be expensive because the park would have to assume ownership and maintenance responsibility for slightly over four miles of overhead powerline. Telephone service is also not reasonably available. Alternative forms of power and communication would be needed at this location. The location also presents a high probability of vandalism, which is a strong disadvantage.

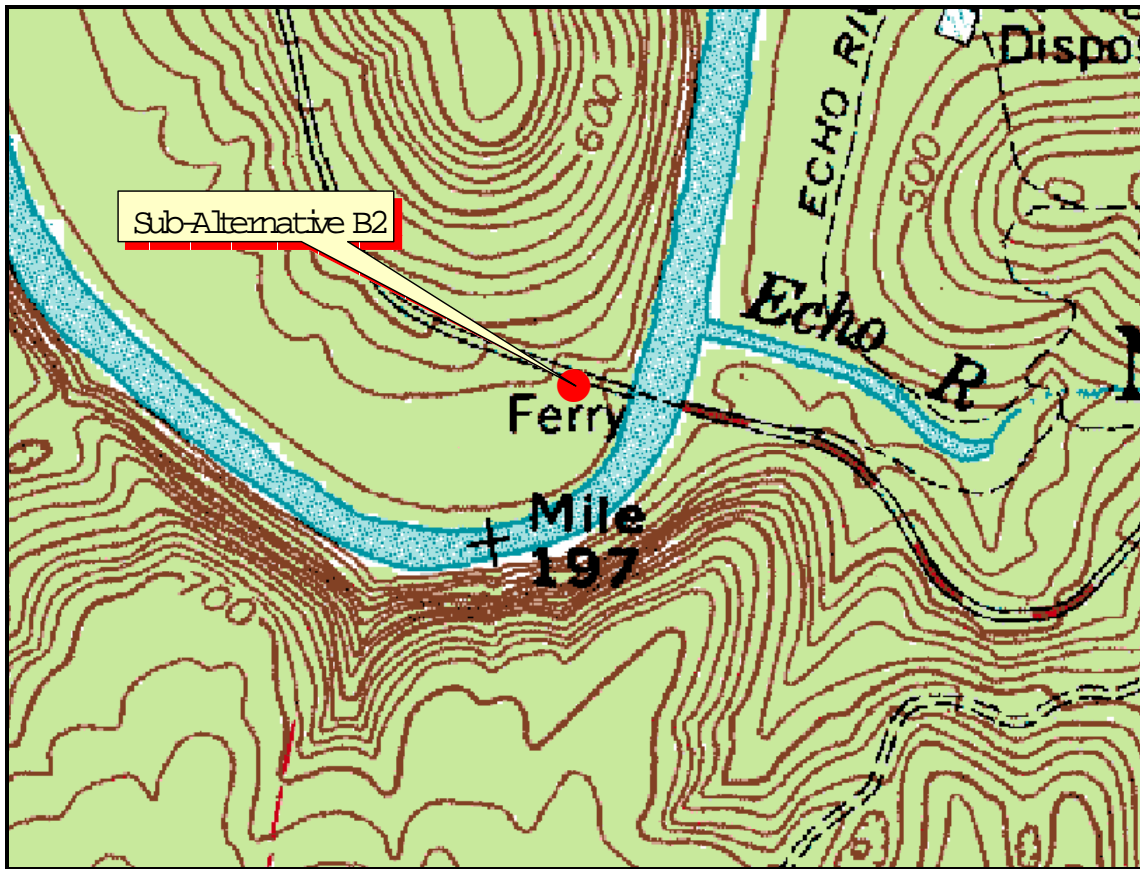


Figure 3. Location of alternative site B2 for mussel culture facility. The red dot indicates the proposed location for the facility.

Sub-Alternative B3. Potential Location of the Mussel Culture Facility on the proposed Western Kentucky University Upper Green River Biological Preserve, i.e., the Williams property (See Figure 4. Below)

This alternative location is about 1 mile outside the northeast boundary of Mammoth Cave National Park (See Figure 4 below). The location is high enough above river bottomland to avoid flooding and close to excellent mussel beds, where federally listed endangered species have been documented. Western Kentucky University is scheduled to complete purchase of the Williams property by May 2003. This site is disturbed and is currently part of a working farm. Electric and telephone service is available. The isolation of this site also has advantages for security of the facilities.

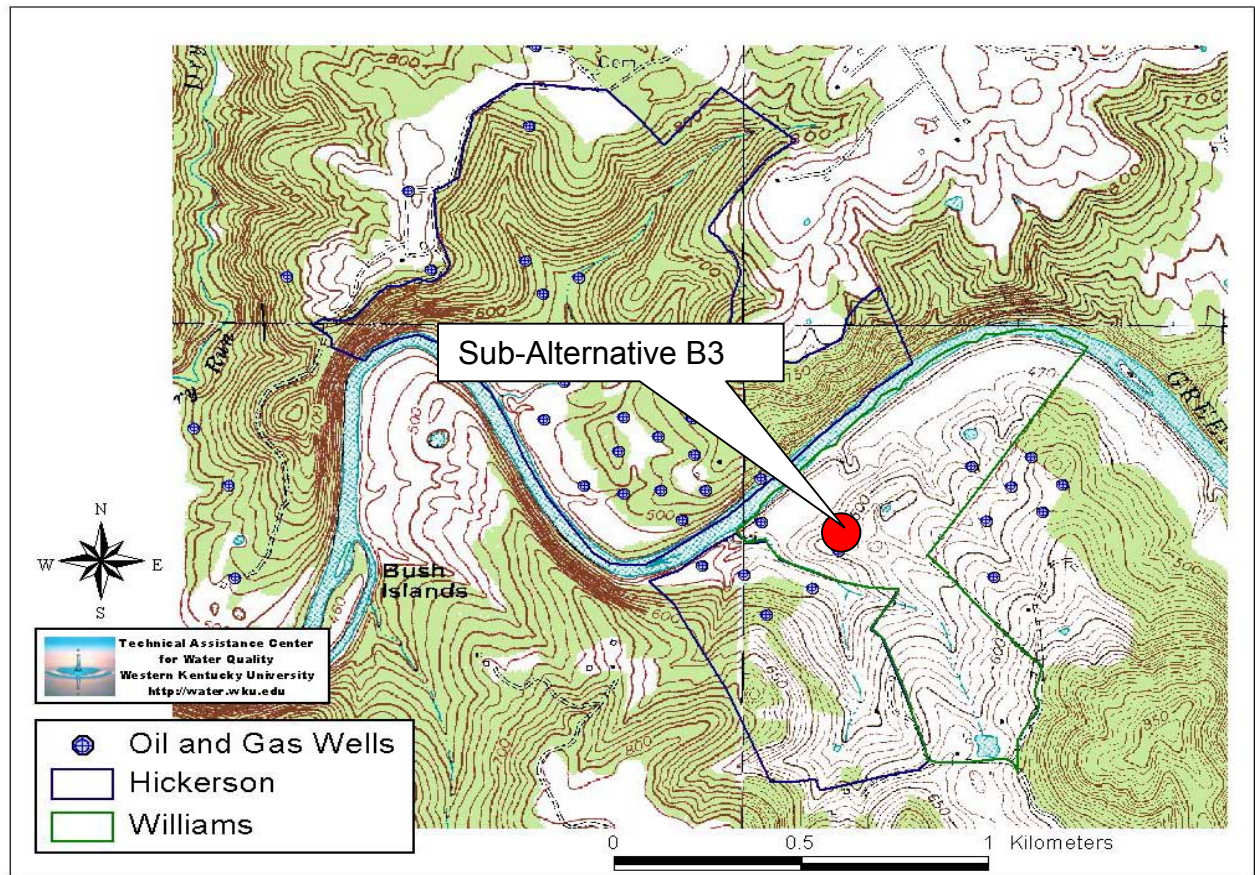


Figure 4. Map of land parcels adjacent to the Green River Western Kentucky University would purchase for proposed Upper Green River Biological Preserve. The red dot indicates the proposed location for the mussel culture facility. The northeast Mammoth Cave National Park boundary is one mile west of this area.

Permit Requirements

The following permits would be required regardless of the location selected.

- National Park Service Scientific Research and Collecting Permit – Dr. Jim Layzer, U.S. Geological Survey, Biological Research Division, stationed at Tennessee Technological University holds a five year research and collecting permit from the park for these activities.
- Endangered Species Act Permit from the U.S. Fish and Wildlife Service – Dr. Layzer will direct the operation of the mussel propagation facility. Dr. Layzer has a U.S. Fish and Wildlife Service permit for the operation of a mussel propagation facility.
- A construction storm water discharge permit if the area disturbed is equal to or greater than one acre. The area of disturbance is expected to be less than ½ acre.
- A permit for withdrawal of water from the Green River is not required because the amount is less than the 10,000 gallon per day threshold.
- A permit may be needed for discharge of the water back into the river after it has circulated through the tanks in the facility.

IDENTIFICATION OF THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

Identification of the “environmentally preferred alternative” is based on evaluation of the direct, indirect, and cumulative impacts on park resources. Cost is not a factor in the selection of the environmentally preferred alternative. The environmentally preferred alternative is the alternative that best promotes the national environmental policy as expressed in the National Environmental Policy Act (NEPA) § 101 (b).⁷

Alternative B has been identified as the environmentally preferred alternative when compared to the No Action alternative. The No Action alternative would not aid the recovery of the seven federally listed, critically imperiled rare mussels in the Green River within Mammoth Cave National Park and would most likely lead to their extinction. Further, the No Action alternative would not restore mussel biodiversity to the levels identified in historical documentation. Alternative B would be implemented by a group of cooperating agencies including the National Park Service, Western Kentucky University, the U.S. Fish and Wildlife Service, Tennessee Technological University, the Kentucky Department of Fish and Wildlife Resources, and the U.S. Army Corps of Engineers.

The environmentally preferred location for the mussel culture facility would be the alternative location that causes the least damage to the biological and physical environment. It is the alternative which best protects, preserves, and enhances historic, cultural, and natural resources. Sub-Alternative B3 has been identified as the environmentally preferred location for the mussel propagation facility because it is located within a currently disturbed site, is above the 100-year floodplain, and has availability of utilities. The installation of the facility can be accomplished at this site with less disturbance than at the other sites considered.

There are attractive features about Sub-Alternatives B1 and B2 but both locations involve new disturbances and high costs for installation and upkeep of utilities. While Sub-Alternative B2, the Green River Ferry site, has power lines currently, Kentucky Utilities is scheduled to remove the power lines in 2003. Retaining the power lines solely for the facility would incur significant maintenance cost, and would prevent abandonment of the utility corridor. Alternative B1, the River Styx site, has the advantage of being near heavily used hiking trails, and thus presents an educational opportunity. However, there are no electrical facilities nearby and locating the mussel culture facility at this site would involve considerable installation costs and greater potential for removal of trees.

In summary, the combination of Alternative B (i.e., Propagate Endangered Mussels) and Sub-Alternative B3 (i.e., the Western Kentucky University Upper Green River Biological Preserve) is identified as the environmentally preferred alternative because it is the alternative that best attains “the widest range of beneficial uses of the environment without degradation, risk of health or safety or other undesirable and unintended consequences.”⁸

⁷ U.S. Department of the Interior, National Park Service. Director’s Order #12, Handbook: Conservation Planning, Environmental Impact Analysis, and Decision Making (§2.7, D.). January 2001, 22.

⁸ Director’s Order #12, Handbook. 23

AFFECTED ENVIRONMENT

THE PARK IN GENERAL

Mammoth Cave National Park is located in south central Kentucky, in the counties of Edmonson, Barren, and Hart. The park is within the Second Congressional District.

In establishing Mammoth Cave National Park, Congress relied heavily on the recommendations of the Southern Appalachian National Park Commission incorporating it into Senate Report No. 823 which in turn was referenced in the Act establishing the park. The Commission recommended that the park contain 28,578 hectares including the extensive limestone caverns and associated topography, portions of the Green and Nolin rivers, and a substantial segment of the rugged landscape north of Green River. The Commission stated that the area containing these features offered

*"exceptional opportunity for developing a great national recreational park of outstanding service in the very heart of our nation's densest population and at a time when the need is increasingly urgent and most inadequately provided for."*⁹

Today the park encompasses 21,380 hectares acquired by a combination of donations and public and private funds. Mammoth Cave National Park contains the world's longest known cave system and offers internationally renowned examples of karst topography. Many types of cave formations are present within the extensive 360 plus mile cave system. The park is part of what is believed to be the most diverse cave ecosystem in the world. Of the more than 130 species of fauna within the cave system, fourteen species of troglobites are known to exist only within Mammoth Cave and other caves in the immediate vicinity. Many of these species have been isolated from other cave systems for over a million years, resulting in fragile and unique populations. One of these species is the federally endangered Kentucky Cave Shrimp *Palaemonias ganteri*. Water of the proper quality and quantity is essential to preserving life within the cave system.

In addition to the world renowned cave system, the park is noted for its outstanding scenic rivers, valleys, bluffs, forests, and abundant wildlife. The park includes twenty-five miles of the Green River and six miles of the Nolin River. The Green River supports a diverse freshwater mussel population including six federal endangered species in addition to its role as the master stream controlling the geologic development of Mammoth Cave and its unique ecosystem.

On October 27, 1981, Mammoth Cave National Park was listed by the United Nations Educational Scientific and Cultural Organization (UNESCO) as a World Heritage Site and on March 27, 1990 as an International Biosphere Reserve. In April 1996, the Mammoth Cave Area Biosphere Reserve was officially extended and now includes lands within Barren, Butler, Edmonson, Hart, Metcalfe, and Warren counties in Kentucky.

⁹ "Final Report of the Southern Appalachian National Park Commission to the Secretary of the Interior, June 30, 1931." United States Government Printing Office. 1931, page 18.

NATURAL RESOURCES

The Rivers

The Green River and its tributary Nolin River flow through the park. These base-level streams possess one of the most diverse fish (84 species) and invertebrate fauna (51 species of mussels alone) in North America. An unused navigation dam (Lock and Dam 6) just beyond the downstream park boundary interrupts normal flow of 16.5 miles of the Green River and all of the Nolin River within the park. Habitats for eight federally listed endangered species are seriously degraded through reduction of natural flow velocity and resultant siltation. The seven federally endangered mussel species are effectively excluded from the Lock and Dam 6 impoundment because the impounded waters do not meet their habitat requirements.

Fishes

Accepted literature, museum records, and a 1990 survey by Cicerello and Hannan indicate the Green River within Mammoth Cave National Park supports 84 fish species or two-thirds of the 121 documented species from the Upper Green River drainage (Burr and Warren 1986).

Federally Listed Endangered Species

The park is located in portions of Barren, Edmonson, and Hart Counties in Kentucky. The species considered in this document are identified by the U.S. Fish and Wildlife Service as known to occur within or with the potential to occur within Mammoth Cave National Park. Species contained in the list which have no known presence within the park are indicated by insertion of (NP) following the common name.

Listed Endangered Species

Indiana Bat	<i>Myotis sodalis</i> ¹⁰
Gray Bat	<i>Myotis grisescens</i>
Red-cockaded Woodpecker (NP)	<i>Picoides borealis</i>
Bachman's Warbler (NP)	<i>Vermivora bachmanii</i>
Kirtland's Warbler (NP)	<i>Dendroica kirtlandii</i>
Kentucky Cave Shrimp	<i>Palaemonias ganteri</i> ¹⁰
Rough Pigtoe	<i>Pleurobema plenum</i>
Clubshell	<i>Pleurobema clava</i>
Ring Pink	<i>Obovaria retusa</i>
Fanshell	<i>Cyprogenia stegaria</i>
Pink Mucket (NP)	<i>Lampsilis abrupta</i>
Orange-Foot Pimpleback (NP)	<i>Plethobasus cooperianus</i>
Cumberlandian Combshell (NP)	<i>Epioblasma brevidens</i>
Northern Riffleshell	<i>Epioblasma torulosa biloba</i>
Tubercled Blossom (NP)	<i>Epioblasma torulosa torulosa</i>
Purple Cat's Paw	<i>Epioblasma obliquata obliquata</i>
Cracking Pearly Mussel	<i>Hemistena lata</i>

¹⁰ Critical habitat has been established within the park for these species.

Hydrology

Mammoth Cave is by far the world's longest known cave system. It is the heart of the Southcentral Kentucky Karst, which is an integrated set of subterranean drainage basins covering more than 644 square kilometers. The surveyed extent of Mammoth Cave currently stands at over 580 kilometers with potential to exceed 1,610 kilometers. There are more than 200 other caves within the park which are disconnected fragments of the larger system or associated with local drainage features. The geology and geography of the area has resulted in a variety of karst basins, which have become the most thoroughly understood conduit-flow aquifers in the world.

The park is bisected east to west by the Green River, which defines the hydrologic base level and divides the region into two distinct physiographic areas. North of the river an alternating series of limestones and insoluble rocks are exposed with the main limestone strata accessible only near the river in the bottom of a few deeply incised valleys. This has resulted in rugged topography with streams that alternately flow on insoluble rocks, over waterfalls, enter caves in limestone, and resurge at springs perched on the next lower stratum of insoluble rock. The caves are numerous but are relatively smaller with smaller drainage basins when compared to Mammoth Cave. South of the Green River the surface and subsurface is defined by the Mammoth Cave karst aquifer, a component of which is the Mammoth Cave System. The complex nature of the Mammoth Cave karst aquifer is demonstrated by the number of groundwater basins, sub-basins, and intricate groundwater flow routes throughout the region. By using data from groundwater traces, we are able to identify which groundwater recharge areas contribute flow into particular points of interest, wells, springs, and caves.

The Mammoth Cave karst aquifer owes the majority of its recharge to areas outside the park boundary. This recharge, in the form of precipitation or the injection of liquid wastes, enters the aquifer through numerous sinking streams and countless sinkholes. Any practices that may have an adverse impact to water quality within the recharge area of the park can directly affect the water quality of the park.

The Mammoth Cave karst aquifer exhibits convergent flow, much like the convergent flow patterns of a dendritic surface stream system. While other aquifers may possess diffuse flow, where contaminants slowly disperse, the convergent flow of the Mammoth Cave karst aquifer would channel recharge and pollutants toward a common trunk conduit or spring.

Flow through the Mammoth Cave karst aquifer can be very rapid, on the order of hundreds to thousands of cubic meters per day. Contaminants entering the karst aquifer can thus be rapidly transported unaltered through the conduit system. The karst aquifer is very dynamic, that is, it responds nearly instantaneously to rainfall. Aquifer stage can rise 10s of meters in a matter of hours (there are numerous records showing stage rises of over 30 meters over the course of one day). In addition, chemical and bacteriological properties of the groundwater can change dramatically following rainfall events. These stage rises can activate high-level overflow routes between groundwater basins and thus direct flow in different directions depending upon aquifer conditions.

Because large portions of the upper Green River watershed and the groundwater basins affecting Mammoth Cave National park lie outside park boundaries, activities conducted in these areas

greatly influence water quality within the park. The primary activities that influence the park's water quality include: disposal of domestic, municipal, and industrial sewage; solid waste disposal; agricultural and forestry management practices; oil and gas exploration and production, urban land-use; and recreational activities.

Since a 1990-92 water quality inventory was completed, several large scale land use changes occurred. The Caveland Sanitation Authority regional sewer program was completed for the Cave City and Park City areas. Hundreds of homes, dozens of businesses, and several small sewage package systems are now connected to a state-of-the-art sewage collection, conveyance, and treatment facility. In the past, during the course of the water quality inventory, each of the above producers discharges sewage on-site via septic systems, dry wells, or sinkholes, and ultimately into Mammoth Cave National Park's karst watershed. Over the past five years the USDA spent nearly \$1,000,000 on Best Management Practices (BMPs) specifically designed to reduce animal waste runoff in the Mammoth Cave region. A total of 83 structures were built between 1990 and 1995. Additionally, the USDA spent hundreds of thousands of dollars on other BMP designed to reduce soil erosion and pesticide use in the Mammoth Cave area. Thus, water quality is likely improving in Mammoth Cave National Park's section of the Green River.

SPECIFIC AREAS AFFECTED BY THIS PROPOSAL

Both alternative sites located within Mammoth Cave National Park are close to the Green River, easily accessible and visible to the public. While the alternative site near River Styx spring at Green River mile 198 (Figure 2) is located near two well-traveled tourist trails and within walking distance of the visitor's center. There is a mussel bed upstream at nearby Cave Island but it is species poor. Further, much of the area near the river is gently sloping bottomland and so well within the Green River's 100-year flood zone. The alternative site on the north shore of the Green River Ferry at Green River mile 197 (Figure 3) is adjacent to Green River Ferry road and so visible to the public. This is a very attractive site because it is at high enough elevation as to be out of flood stage. There are no mussel beds near the Green River Ferry alternative site. Both these alternative sites are located in Mammoth Cave National Park development zones.

The preferred alternative site for the mussel culture facility is 1km east of Mammoth Cave National Park's northeast boundary on a 1.72 km piece of property located on the south bank of the Green River (Figure 4). This land is near several mussel beds in the Green River, including one where five federally listed endangered mussels have been recently documented, i.e., *Cyprogenia stegaria*, *Epioblasma torulosa torulosa*, *Obovaria retusa*, *Pleurobema clava*, and *P. plenum*. The original forests were cleared in the late 1700s and early 1800s. The site was used before establishment of the park in 1941 for farms, gardens, and residences. There were water lines and above ground electric and telephone service. Parts of these properties have been used for oil extraction, gravel mining, cattle grazing, and crop production up to the present day. There is some second growth forest on this property.

Western Kentucky University management plans for the Upper Green River Biological Preserve include the elimination of environmentally unsound practices similar to practices that were eliminated once Mammoth Cave National Park was established. For example, once the land is purchased Western Kentucky University would cap oil wells and remove tanks and flow lines in order to protect the river from oil spills, eliminate access for gravel mining in mussel beds, and

eliminate cattle grazing that has caused erosion along the banks of the Green River. Further, access to the proposed site is highly restricted, only one gated road would run to the facility, relative to proposed locations in Mammoth Cave National Park. Finally, public outreach would be supported by Western Kentucky University's Center for Mathematics, Science and Environmental Education. The Center would coordinate environmental education activities in the Upper Green River Biological Preserve for K-12 teachers and students as well as college students and the general public; such activities would undoubtedly include information on the mussel culture facility.

Wetlands and Floodplains

There are no wetlands that would be affected by installation of a mussel propagation facility at any of the alternative sites. Each of the three alternative sites is adjacent to the Green River floodplain. Regardless of the site selected, the propagation facility would be placed at an elevation above the 100-year floodplain. Intake and discharge pipes would be buried across the floodplain to a depth of approximately two feet.

Vegetation

Vegetation at the Green River Ferry site is maintained turf grass lawn. Vegetation at the River Styx site is made up of sparsely distributed canopy height trees. The environmentally preferred alternative site contains multiple upland and bottomland pastures in need of restoration to native vegetation.

Threatened and Endangered Species

All alternative sites have some federally protected species present within or near the affected site area. Federally listed mussels are found in the Green River at all three alternative sites. Five species of endangered mussels are known to be present in mussel beds adjacent to the project area at the environmentally preferred alternative site. Further, the primary activity proposed by this project is propagation of endangered mussels for the purpose of restocking them into the Green River. Endangered mussels would be removed from the Green River and taken to Tennessee Technological University where propagation would take place. The juvenile mussels and the brood stock would then be placed in the mussel culture facility in or near Mammoth Cave National Park. After the juvenile mussels are reared to a sufficient age they would be stocked in the Green River at locations with suitable habitat.

The Kentucky Cave Shrimp is known from the groundwater basin that feeds the McCoy Blue Hole spring on the north side of the river, near the environmentally preferred alternative site, which is on the south side of the river. Drainage from the project area can be assumed, under some conditions, to reach at least some portion of the cave that may contain the cave shrimp. Federally listed Indiana and Gray bats are likely present in caves near the alternative sites and would be expected to forage in the sites. The Indiana bat would also be expected to roost in trees in or near all three alternative sites. Eggert's Sunflower (federally threatened) may be present on the Western Kentucky University property but it has not been found in the proposed site. The Bald Eagle (federally threatened) is present in Mammoth Cave National Park at least seasonally, but is usually seen in or near the river valleys in the northwestern quadrant of the park

and has not been seen in the alternative sites. A federal candidate species, the Surprising Cave Beetle, is found in a cave approximately 1/2 miles from the two alternative sites within Mammoth Cave National Park.

Air Quality

Due to their relative proximity, air quality is assumed to be the same among all alternative sites. Mammoth Cave National Park is a Class I area under the Clean Air Act. Based on data collected from 1991-1999, Mammoth Cave National Park ranks as the third most polluted National Park in the United States. The measures used in developing the ranking were visibility, ozone, and acid precipitation.¹¹ The park has recently initiated monitoring for mercury. Monitoring is not conducted within the environmentally preferred alternative site.

Soils/Geology

Soils among all alternative sites are disturbed from past agricultural processes but the environmentally preferred alternative site contains soils that are more recently disturbed. Doubtless there would be some soil compaction during the installation process but it would be relatively minor.

Water Quality and Hydrology

All alternative sites are located near the Green River. There is some potential for siltation during the installation process but this would be minimized with barriers. The Green River Ferry site is located on Green River mile 197 near Echo River Spring. The River Styx site is located on Green River mile 198 just upriver of River Styx spring. The environmentally preferred alternative site is located near McCoy Blue Hole, one of the largest springs along the Green River. McCoy Blue Hole empties an underground karst drainage of 55.4 km² into the Green River. The long term potential for the mussel culture facility to negatively affect Green River water quality is negligible.

Fish & Wildlife Other than Threatened and Endangered Species

For all alternative sites the most commonly seen wildlife in the project area are deer, squirrels, common insects, and common bird species.

Migratory Birds

A number of migratory birds pass through all alternative sites seasonally. None of the federally threatened or endangered species of migratory birds is known to be present in or to migrate through the park or any of the alternative sites.

Cultural Resources

No cultural resources are known from either alternative site within Mammoth Cave National Park.

¹¹ Polluted Parks in Peril: The Five Most Air Polluted National Parks in the United States. Compiled by Harvard G. Ayers, Appalachian State University. Boone, North Carolina. October 2000, p. 1.

What may be the oldest building standing in Hart County, a house constructed in 1803, is located near the environmentally preferred alternative site. Money to stabilize the structure is included in the budget for the Upper Green River Biological Preserve. The building would likely be fully restored at some point. Although the building is located within the proposed Preserve the alternative site for the mussel propagation facility is not adjacent or visible from the building location.

An archeological survey of the Upper Green River Biological Preserve site was completed in March 2003 by the University of Kentucky Program for Archeological Research. The survey found 14 prehistoric artifacts, but none were temporally diagnostic. There was no evidence found of intact features or deposits below the plowzone. The report contained the following recommendation.

“Given the light artifact density, the lack of diagnostic artifacts, and the lack of intact features or deposits below the plowzone, the potential for further research at Site 15HT78 is limited. Therefore, Site 15HT78 is considered not eligible for nomination to the NRHP under Criteria A-D. No further archaeological work is recommended.”¹²

Visitor Use

Regardless of its location access to the mussel culture facility would be relatively restricted. The alternative sites within Mammoth Cave National Park experience some amount of visitor traffic throughout the year; but especially during the spring and summer months. The land surrounding the environmentally preferred alternative site would eventually be used for environmental education activities for K-12 teachers and students as well as college and general public audiences. Undergraduate projects and research projects would also be conducted on the property.

Land Use

Both alternative sites within Mammoth Cave National Park are located within the park development zone. Western Kentucky University’s management plan for the property surrounding the environmentally preferred alternative site outlines practices to protect the biodiversity of all habitats within. The management plan states that the property would only be used for educational purposes of low impact. Hart County does not have a zoning system. No changes in land use zoning or designation would be required for any of the alternative sites.

Transportation

Only the Green River Ferry site is near a public road. The Green River Ferry Road while important to access within the park and nearby communities does not serve as a transportation corridor between major population centers.

¹² Loughlin, Michael L. and Katie Becraft. A Phase I Archaeological Survey for a Proposed Mussel Propagation Facility Near Mammoth Cave National Park, Hart County, Kentucky (NPS Order #H5530030020). Program for Archeological Research, University of Kentucky, Lexington, March 10, 2003, 27.

Social and Economic

Mammoth Cave National Park has been a major tourist attraction in Kentucky for over 190 years. The park generates a significant contribution to the economy of gateway communities, and is important on a statewide level. Accomplishment of the park mission is an important social factor and includes protection and enhancement of habitat for threatened or endangered species.

Energy Requirements & Conservation

Regardless of its location, the mussel culture facility would utilize energy efficient technologies for insulation, power supply and backup power supply.

Public Safety

To provide for safety of the public and security of the facility, access to the mussel culture facility would be relatively restricted. The mussel culture facility would have security systems and barriers to deter vandalism.

Public Health

There are no public health concerns associated with this project.

Indian Trust Resources

There is no information about Indian Trust Resources among the alternative sites.

ENVIRONMENTAL CONSEQUENCES

Following is a table that summarizes the probable impacts of the alternatives related to the relevant resources or resource values that may be affected by the proposed project. The need for mitigating actions, if any, is identified for each resource value. Following the table is a narrative discussion of the effects of the proposal related to each resource or resource value.

Impacts or potential impacts have at least three important attributes: context (i.e., location in space and time), duration, and intensity or severity. In the following discussion, the terms impact, effect, and environmental consequences are used interchangeably. Impacts are direct, indirect, and/or cumulative. Impacts can be adverse or beneficial. The duration of impacts is defined as temporary (less than two years), short-term (two to five years), long-term (five to twenty years), and permanent (more than twenty years). The intensity of impacts is described using the following threshold terms: negligible, minor, moderate, major, impairment. The following descriptions of the thresholds are for natural resource issues. Analogous relative threshold factors are employed for the other issues. Negligible impacts are so minute that they have no observable effect, and parameter measurements are well within the natural range of variability. Minor impacts are detectable, parameter measurements are within the natural range of variability, but are not expected to have any long-term effects. Moderate impacts are detectable, parameter measurements are outside the natural range of variability for short periods, and changes may be long-term. Major impacts are detectable, parameter measurements are outside the natural range of variability for short to long periods, and changes may be long-term to permanent. Impairment occurs when major impacts occur which have significant and usually permanent effects on park resources or values as defined in Section 1.4 of the National Park Service Management Policies 2001 (December 2000, p. 11-13).

IMPACT SUMMARY TABLE

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
WETLANDS AND FLOODPLAINS– Impacts would occur if wetlands are dredged or filled. There are no wet lands that would be affected at any of the alternative sites. Each alternative site is adjacent to the 100-year floodplain, and intake and discharge pipes would be buried across the floodplain to provide water for the mussel culture tanks and trays.				
Description of Attributes	No wetlands or floodplains	Trenching for pipes across floodplain	Trenching for pipes across floodplain	Trenching for pipes across floodplain
Type of Effect	No Effect	Direct	Direct	Direct
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Long-Term	Long-Term	Long-Term
Mitigating Actions Needed: None.				

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
VEGETATION – The vegetation at each alternative site is part of a non-historic managed landscape.				
Description of Attributes	No effect	No trees would be removed. Trenching would damage or disturb tree roots.	No trees would be removed. Trenching would damage or disturb tree roots.	No trees would be removed. Trenching would damage or disturb tree roots.
Type of Effect	No effect	Direct	Direct	Direct
Severity	No effect	Negligible	Negligible	Negligible
Duration	No effect	Short-Term	Short-Term	Short-Term
Mitigating Actions Needed: If tree removal should conform to the park “Hazard Tree Management Plan,” approved June 20, 2000, if tree removal is becomes necessary. Currently no tree removal is expected to be required for any of the alternatives. The plan specifies actions necessary to avoid unintentional or incidental taking of Indiana bats.				

THREATENED AND ENDANGERED SPECIES – Indiana and Gray bats likely forage in the project area, and Indiana bats may roost in trees in the project area. The Bald Eagle is seldom seen in the project area. The project alternative sites are in or near groundwater basins that contain the Kentucky Cave Shrimp. The impact of disturbance is expected to be minimal except during installation, which would be of relatively short duration. Endangered mussels would be removed from the Green River for propagation and restocking. Water removed from the river would be returned to the river after being circulated through the tanks and trays in the mussel culture facility.				
Description of Attributes	No Effect	Construction noise and runoff entering cave system Propagation of endangered mussels	Construction noise and runoff entering cave system Propagation of endangered mussels	Construction noise and runoff entering cave system Propagation of endangered mussels
Type of Effect	No Effect	Direct and Indirect	Direct and Indirect	Direct and Indirect
Severity	No Effect	Mussels: Major beneficial Bats and other T&E: Negligible	Mussels: Major beneficial Bats and other T&E: Negligible	Mussels: Major beneficial Bats and other T&E: Negligible
Duration	No Effect	Mussels: Long-term to Permanent Bats and other T&E: Temporary	Mussels: Long-term to Permanent Bats and other T&E: Temporary	Mussels: Long-term to Permanent Bats and other T&E: Temporary
Mitigating Actions Needed: All tree removal activities should conform to the park “Hazard Tree Management Plan” (approved June 20, 2000). Ensure adequate erosion control plan is in place and followed. The alternative sites are all near the Green River with the result that there is very limited opportunity for runoff from these sites to travel through any appreciable amount of cave shrimp habitat. The proposed mussel propagation is an attempt to mitigate the adverse effects that human activities have had on mussel populations in the Upper Green River basin.				

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
AIR QUALITY – Some amount of dust and particulates would be produced by construction during dry weather.				
Description of Attributes	No Dust or particles from construction	Dust and fine particulates from construction	Dust and fine particulates from construction	Dust and fine particulates from construction
Type of Effect	No Effect	Indirect	Indirect	Indirect
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Short-term	Short-term	Short-term
Mitigating Actions Needed: Dust should be controlled if it becomes an issue during construction.				

SOILS / GEOLOGY – The primary issues are ground disturbance and erosion prevention during construction. Based on the nature of the mussel culture facility, rock excavation, if any, would be minimal. The effect of any ground disturbance is likely permanent. Site would be graded and leveled. The amount of grading varies between the sites.				
Description of Attributes	No Dust or particles from construction	Moderate grading and leveling of site	Most grading and leveling of site	Least grading and leveling of site
Type of Effect	No Effect	Direct	Direct	Direct
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Permanent	Permanent	Permanent
Mitigating Actions Needed: None				

WATER QUALITY AND HYDROLOGY – Stormwater runoff during construction could, if not mitigated, result in erosion and sedimentation.				
Description of Attributes	No construction	Erosion and downstream sedimentation	Erosion and downstream sedimentation	Erosion and downstream sedimentation
Type of Effect	No Effect	Direct and Indirect	Direct and Indirect	Direct and Indirect
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Temporary	Temporary	Temporary
Mitigating Actions Needed: Control stormwater runoff during construction to prevent erosion and downstream sedimentation.				

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
FISH & WILDLIFE (other than threatened or endangered species) – Effects are primarily from noise and other disturbances during the period of construction. The impact of disturbance is expected to be minimal except during installation, which would be a relatively short period.				
Description of Attributes	No construction	Construction noise and disturbance	Construction noise and disturbance	Construction noise and disturbance
Type of Effect	No Effect	Direct and Indirect	Direct and Indirect	Direct and Indirect
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Temporary	Temporary	Temporary
Mitigating Actions Needed: None				

MIGRATORY BIRDS – Effects are noise and disturbance during the period of construction. The threatened or endangered migratory bird species are not known to be present or to migrate through the property.				
Description of Attributes	No construction	Construction noise and disturbance	Construction noise and disturbance	Construction noise and disturbance
Type of Effect	No Effect	Direct and Indirect	Direct and Indirect	Direct and Indirect
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Temporary	Temporary	Temporary
Mitigating Actions Needed: None				

CULTURAL RESOURCES – There may be cultural resources at the site of sub-alternative B3. Archeological surveys would be conducted by UK-PAR. The sites have been previously disturbed. The position of the facilities would be adjusted to avoid archeological resources if any are found.				
Description of Attributes	No Construction	No Cultural Resources Present	No Cultural Resources Present	Possible Cultural Resources Present
Type of Effect	No Effect	No Effect	No Effect	Direct and Indirect
Severity	No Effect	No Effect	No Effect	Negligible
Duration	No Effect	No Effect	No Effect	Temporary
Mitigating Actions Needed: Location of facilities would be adjusted to avoid archeological resources if any are found.				

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
VISITOR USE – Construction work would/would not be visible to visitors.				
Description of Attributes	No Construction No facility	Construction would be visible	Construction would be visible	Construction would not be visible
Type of Effect	No effect	Direct and Indirect	Direct and Indirect	Direct and Indirect
Severity	No construction effects	Negligible	Negligible	Negligible
Duration	No construction effects	Temporary	Temporary	Temporary
Mitigating Actions Needed: None				

LAND USE – The proposal would not require any changes in land use or land use designations.				
Description of Attributes	No facility	Facility located in Designated development zone	Facility located in Designated development zone	Outside park boundary in area with no zoning
Type of Effect	No Effect	No Effect	No Effect	No Effect
Severity	No Effect	No Effect	No Effect	No Effect
Duration	No Effect	No Effect	No Effect	No Effect
Mitigating Actions Needed: None. No changes in land use designation are required or needed.				

TRANSPORTATION – Moving trailer and installation may require traffic control for safety. Sites would not effect transportation corridors between major population centers.				
Description of Attributes	No construction traffic	Traffic control for safe entry and exit of vehicles and equipment from site	Traffic control for safe entry and exit of vehicles and equipment from site	Traffic control for safe entry and exit of vehicles and equipment from site
Type of Effect	No Effect	Indirect	Indirect	Indirect
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Temporary	Temporary	Temporary
Mitigating Actions Needed: Insure the contractor performs as specified to maintain traffic flow.				

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
SOCIAL AND ECONOMIC – The primary effects are the construction funds that would be paid to the contractor. In this case, purchase and installation of the trailer is the main component.				
Description of Attributes	No Construction	Construction dollars effect on economy	Construction dollars effect on economy	Construction dollars effect on economy
Type of Effect	No Effect	Indirect	Indirect	Indirect
Severity	No Effect	Negligible	Negligible	Negligible
Duration	No Effect	Temporary	Temporary	Temporary
Mitigating Actions Needed: None				

PUBLIC HEALTH – There are no public health concerns associated with this project. Water withdrawn from the Green River would be returned after circulation through the mussel propagation facility. No substances would be added or subtracted from the water except for the filtration by mussels.				
Description of Attributes	No Effect	No Effect	No Effect	No Effect
Type of Effect	No Effect	No Effect	No Effect	No Effect
Severity	No Effect	No Effect	No Effect	No Effect
Duration	No Effect	No Effect	No Effect	No Effect
Mitigating Actions Needed: None				

PUBLIC SAFETY – Security and safety measures would be included at each of the alternative sites. Integrity of the culture facility needs to be assured for the project to be successful. Nevertheless the facility would have no effect on public safety.				
Description of Attributes	No Effect	Fence/Alarm systems	Fence/Alarm systems	Fence/Alarm systems
Type of Effect	No Effect	No Effect	No Effect	No Effect
Severity	No Effect	No Effect	No Effect	No Effect
Duration	No Effect	No Effect	No Effect	No Effect
Mitigating Actions Needed: None				

RESOURCE OR IMPACT CATEGORY	ALTERNATIVE A	ALTERNATIVE B		
	No Action	Sub-alternative B1 River Styx Site	Sub-alternative B2 Green River Ferry Site	Sub-alternative B3 Western Kentucky University Site
INDIAN TRUST RESOURCES - There are no Indian Trust Resources in the park or Western Kentucky University property, and the neither retains any records or other information of Indian Trust resources.				
Description of Attributes	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Type of Effect	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Severity	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Duration	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Mitigating Actions Needed: None				

RISK OF UNANTICIPATED CONSEQUENCES – Because the site has been previously disturbed, the risk of unanticipated environmental effects is minimal. The primary risk is that the facility would not be successful in rearing endangered mussels through their juvenile stage in sufficient numbers to restock the Green River. Additional commitment of resources could be needed to develop and implement techniques that would be successful.				
Description of Attributes	Mussels would not be reared	Mussels rearing could be less successful than projected	Mussels rearing could be less successful than projected	Mussels rearing could be less successful than projected
Type of Effect	No Effect	Indirect	Indirect	Indirect
Severity	N/A	Negligible risk	Negligible risk	Negligible risk
Duration	N/A	Short Term	Short Term	Short Term
Mitigating Actions Needed: None				

CUMULATIVE IMPACTS – Cumulative impacts include other actions governmental and private that can reasonably be predicted to occur as a result of implementation of each alternative. The project eventually could result in removal of some mussel species from the endangered species list. There is also potential, if the technology proves itself, of raising mussels from other rivers, e.g., Ohio River species.				
Description of Attributes	No cumulative impacts expected	Removal of species from the endangered list	Removal of species from the endangered list	Removal of species from the endangered list
Type of Effect	No Effect	Indirect	Indirect	Indirect
Severity	N/A	Major	Major	Major
Duration	N/A	Long Term	Long Term	Long Term
Mitigating Actions Needed: None				

ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

The following discussion summarizes the likely effects of the alternatives for each resource or resource value evaluated in this environmental assessment. Cumulative effects and impairment are also discussed for each resource category.

Cumulative effects are the additional actions by any entity that can reasonably be predicted to occur as a result of the proposed action. Cumulative impact is defined by the Council on Environmental Quality regulations in 40 C.F.R. Section 1508.7 as:

“the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.”

The meaning of impairment is spelled out in the National Park Service (National Park Service) Organic Act of 1916 (16 USC 1); the National Park Service General Authorities Act of 1970, including amendments in 1978 (16 USC 1a-1); and the National Park Service Management Policies 2001 (Section 1.4). Impairment means impact(s)

“that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.”¹³

The effects of the three action alternatives on most resources or resource values are similar, if not identical, because each alternative requires a comparable level of construction on the similar sites. In the following discussion of the environmental consequences, they are referred to collectively as the proposal. In cases where there is a discernable difference in the effects of the action alternatives, they are identified separately.

WETLANDS AND FLOODPLAINS

There are no wet lands that would be affected at any of the alternative sites. Each alternative site is adjacent to the 100-year floodplain, and intake and discharge pipes would be buried across the floodplain to provide water for the mussel culture tanks and trays. The proposal would not adversely effect wetlands or floodplains.

No Action. The no action alternative would not affect wetlands or floodplains.

Impairment. The proposal would not impair wetlands or floodplains. The no action alternative would not impair wetlands or floodplains.

Cumulative Effects. There are no cumulative effects on wetlands or floodplains.

¹³ National Park Service Management Policies 2001, Section 1.4.5. December 2000, p. 12.

VEGETATION

Alternative sites B1 and B2 contain bottomland vegetation. Trenching at sites B1 and B2 would result in severed tree roots and removal of underbrush. Alternative site B3 contains multiple upland and bottomland pastures, and the effects of trenching would be limited. While trenching would be necessary to install the mussel culture facility's intake and outflow hoses the impact on vegetation would be minor and temporary.

No Action. The no action alternative would not effect vegetation.

Impairment. The proposal would not impair vegetation or natural processes. The no action alternative would not impair vegetation.

Cumulative Effects. There are no measurable cumulative effects on vegetation because of the proposal.

THREATENED AND ENDANGERED SPECIES

Indiana and Gray bats (endangered) are likely to forage in the project area, and Indiana bats may roost in trees and caves in all alternative sites from April 1 through November 15 annually. The primary effect from construction and operation of the facility would be noise. It is not anticipated that any trees would be removed. However, if removal of trees becomes necessary the removal would be performed under the guidelines in the park Hazard Tree and Vegetation Management Plan. The plan was developed in consultation with the U.S. Fish and Wildlife Service and specifies conditions for removal of trees to prevent the inadvertent taking of Indiana bats.¹⁴ The proposal is not likely to adversely effect Indiana or Gray bats.

The Bald Eagle (threatened) has a transient presence in all alternative sites, but is seldom seen. No effects are expected related to the Bald Eagle.

The River Styx site (B1) is within the Echo River groundwater basin that contains the Kentucky Cave Shrimp (endangered). The Green River Ferry site (B2) is on the north side of the river and is not associated with any identified groundwater basin. The Western Kentucky University site is south of Green River and the identified groundwater basin that contains endangered shrimp is on the opposite side of the river. The potential effects are related to runoff from the sites during construction. Adequate controls are needed to prevent erosion and sedimentation as well as to capture any spills of hazardous materials. It is expected that standard erosion control methods would be installed early in the construction period, which would further reduce the chances of sediments or hazardous materials entering the groundwater from the site. Stormwater runoff from the sites is not likely to enter cave streams because local topography will channel runoff directly into the Green River. No adverse effects are expected related to the Kentucky Cave Shrimp.

The proposal includes areas near the Green River, which provides habitat for seven species of endangered mussels. Water removed from the river would be returned to the river after being

¹⁴ See Mammoth Cave National Park Standard Operating Procedures Handbook, Section H. Chapter 1. See also Mammoth Cave National Park Impact Assessment file IA-0003, "Revise Hazard Tree and Vegetation Management Plan."

circulated through the tanks and trays within the propagation facility. Because the proposal would propagate and restore endangered mussel populations in the Green River, the proposal would result in beneficial effects on endangered mussel species.

The Surprising Cave Beetle (candidate for federal endangered status) is located in caves which are far from the construction site. The proposal is not likely to affect the Surprising Cave Beetle.

In summary, the proposal is likely to benefit the status of endangered mussels and is not likely to adversely effect other threatened and endangered species.

No Action. The no action proposal would not effect threatened and endangered species.

Impairment. The proposal would not impair threatened and endangered species. The no action alternative would not impair threatened and endangered species.

Cumulative Effects. The proposal could produce cumulative effects related to threatened and endangered mussels. Over a period of time, if the project is successful, it could lead to the eventual removal of some species from the threatened and endangered species list.

AIR QUALITY

The primary effects would be dust and fine particulates produced by construction activities in dry weather. Controls are required to prevent production of excessive amounts of dust. The effects are expected to be negligible and temporary.

No Action. The no action alternative would have no effect on air quality.

Impairment. The proposal would not impair air quality. The no action alternative would not impair air quality.

Cumulative Effects. There are no cumulative effects on air quality because of the proposal.

SOILS AND GEOLOGY

The primary issues are ground disturbance and erosion prevention during construction. Appropriate erosion and sedimentation control measures would be in place at all times. The soils at each of the alternative locations have been previously disturbed by agricultural activities. No rock excavation is anticipated. The effects on geology and soils within the areas of reconstruction are negligible but permanent.

No Action. The no action alternative would not effect soils and geology.

Impairment. The proposal would not impair soils and geology. The no action alternative would not impair soils and geology.

Cumulative Effects. There are no cumulative effects on soils and geology.

WATER QUALITY AND HYDROLOGY

Stormwater runoff during construction, if not properly mitigated with silt fencing or other erosion control devices, could result in erosion and sedimentation. The effects are expected to be temporary and negligible.

No Action. The no action alternative would not effect water quality and hydrology.

Impairment. The proposal would not impair water quality and hydrology. The no action alternative would not impair water quality and hydrology.

Cumulative Effects. There would be no cumulative effects related to water quality and hydrology.

FISH AND WILDLIFE (OTHER THAN THREATENED OR ENDANGERED SPECIES)

The effects are similar to the effects on threatened or endangered species. However, abundant species would be present near the construction areas and would be exposed to the construction disturbance and noise associated with operation of the facility. The effects are expected to be negligible but long term.

No Action. The no action alternative would not effect fish and wildlife.

Impairment. The proposal would not impair fish and wildlife. The no action alternative would not impair fish and wildlife.

Cumulative Effects. There would be no cumulative effects on fish and wildlife.

MIGRATORY BIRDS

The effects on migratory birds are primarily noise and other physical disturbance. No threatened and endangered migratory bird species are known to be present or to migrate through the sites. Construction is expected to produce temporary negligible effects on migratory birds.

No Action. The no action alternative would not effect migratory birds.

Impairment. The proposal would not impair migratory birds. The no action alternative would not impair migratory birds.

Cumulative Effects. There would be no cumulative effects on migratory birds.

CULTURAL RESOURCES

Archeological survey of the project area would be completed before any ground disturbance. The trailer and trenching locations would be adjusted to avoid adverse impacts if any archeological materials or features are discovered that would warrant avoidance. The University of Kentucky Program for Archeological Research would conduct the surveys in March 2003.

No Action. The no action alternative would have no effect on cultural resources.

Impairment. The proposal would not impair cultural resources. The no action alternative would not impair cultural resources.

Cumulative Effects. There would be no cumulative effects on cultural resources.

VISITOR USE

The trailer would be visible to visitors in Mammoth Cave National Park but not on the Western Kentucky University property. The project would allow cave tours and other visitor services to continue without disruption. The primary effect on visitors would be to provoke their curiosity as to nature of the facility. All available media would be used to keep visitors informed. The construction effects related to visitor use would be negligible and short-term.

No Action. The no action alternative would not effect visitor use.

Impairment. The proposal would not impair visitor use. The no action alternative would not impair visitor use.

Cumulative Effects. There would be no cumulative effects related to visitor use.

LAND USE

The proposal would not require any changes in land use or land use designations. No effects are expected.

No Action. The no action alternative would not effect land use or land use designations.

Impairment. The proposal would not impair land use. The no action alternative would not impair land use.

Cumulative Effects. The proposal would have no cumulative effects related to land use.

TRANSPORTATION

The sites are not near major transportation routes. Short-term negligible effects on traffic in the immediate vicinity of Green River Ferry would be anticipated during the installation of the trailer. The effects would be present less than eight hours.

No Action. The no action alternative would have no effect on transportation.

Impairment. The proposal would not impair transportation. The no action alternative would not impair transportation.

Cumulative Effects. There would be no cumulative effects on transportation.

SOCIAL AND ECONOMIC

The primary social and economic issue is the construction funds that would be paid to the contractor for purchase and installation of the trailer. These funds would then enter the economy in a variety of ways. The amount of funds would be negligible, and the effects are expected to be negligible and short-term.

No Action. The no action alternative would be expected to have no effect on social or economic values.

Impairment. The proposal would not impair social and economic values. The no action alternative would not impair social and economic values.

Cumulative Effects. There would be no cumulative social or economic effects.

ENERGY REQUIREMENTS AND CONSERVATION

All alternatives sites would utilize energy efficient technology on the existing facilities. All alternatives would result in permanent minor beneficial effects.

No Action. The no action alternative would have no effect on energy requirements and conservation.

Impairment. There would be no impairment related to energy requirements and conservation. The no action alternative would not impair energy requirements and conservation.

Cumulative Effects. There would be no cumulative effects related to energy requirements and conservation.

PUBLIC HEALTH

The project would not affect public health.

No Action. The no action alternative would not affect public health.

Impairment. There would be no impairment of public health. The no action alternative would not impair public health.

Cumulative Effects. There would be no cumulative effects related to public health.

PUBLIC SAFETY

Security and safety measures would be incorporated in the facility regardless of which site is selected. The proposal would not effect public safety.

No Action. The no action alternative would not affect public safety.

Impairment. There would be no impairment of public safety. The no action alternative would not impair public safety.

Cumulative Effects. There would be no cumulative effects related to public safety.

INDIAN TRUST RESOURCES

There are no Indian Trust resources in the park or the Western Kentucky University property, and neither has or retains any records or other information related to Indian Trust resources. There would be no effect on Indian Trust resources.

No Action. The no action alternative would not effect Indian Trust resources.

Impairment. There would be no impairment of Indian Trust resources. The no action alternative would not impair Indian Trust resources.

Cumulative Effects. There would be no cumulative effects related to Indian Trust resources.

RISK OF UNANTICIPATED CONSEQUENCES

Because of the nature of the mussel culture facility and the relative ease of connection to preexisting utilities at the preferred alternative location the risk of unanticipated consequences is limited. Adequate contract supervision and project inspection to insure the work remains on schedule would mitigate that risk. The more significant risk is that the facility would not, in its initial configuration, successfully rear endangered mussels of all seven species in sufficient numbers to restock the Green River. More time and resources would then be required to make adjustments to the facility and/or to the protocols for rearing of juvenile mussels of one or more species.

No Action. The no action alternative would not have a risk of unanticipated consequences.

Impairment. There would be no impairment associated with the risk of unanticipated consequences.

Cumulative Effects. There are no reasonably discernable cumulative effects related to unanticipated consequences. The no action alternative could result in extinction of one or more species.

CUMULATIVE IMPACTS

Cumulative impact is defined by the Council on Environmental Quality regulations in 40 C.F.R. Section 1508.7 as:

“the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.”

If the proposal is successful in rearing endangered mussels in sufficient quantities to restock the Green River in large numbers, it may eventually lead to the removal of some species from the threatened and endangered species list. The techniques could be transferred to mussel restocking efforts in other geographic locations. There is also potential, if the technology proves itself, of raising mussels from other rivers, e.g., Ohio River species. No other cumulative effects have been identified related to this project.

No Action. The no action alternative would likely result in extinction of one or more mussel species in the upper Green River.

Impairment. There would be no impairment of resources related to the cumulative effects of the proposal. The no action alternative could result in the extinction of one or more mussel species.

SUMMARY OF MITIGATING ACTIONS

The following list restates the mitigating actions identified in the preceding discussion of the likely environmental consequences of the proposal. These are the important conditions that should be utilized to limit the potential for unexpected adverse consequences.

Although no tree removal is anticipated, if tree removal becomes necessary, it would conform to the park "Hazard Tree Management Plan" (approved June 20, 2000). The park completed formal consultation with the U.S. Fish and Wildlife Service before approval of the plan. The primary issue is protection of Indiana bats. Any trees to be removed should be removed when Indiana bats are hibernating in caves (November 15th to March 31st) and therefore are unlikely to be roosting in trees.

Dust should be controlled if it becomes an issue during construction.

Erosion and sedimentation control measures should be in place to prevent movement of soils from the site into the cave system.

Location of facilities would be adjusted to avoid archeological resources if any are found.

Effective construction management and supervision should be provided to insure that public safety and other concerns related to construction are properly addressed, and that any contractors perform as specified.

CONSULTATION AND COORDINATION

Kentucky State Clearinghouse in the Kentucky Natural Resources and Environmental Protection Cabinet (The clearinghouse distributed copies to the following Kentucky State Agencies.):

Division of Water
Division of Waste Management
Division for Air Quality
Department of Health Services
Economic Development Cabinet
Division of Forestry
Department of Surface Mining Reclamation and Enforcement
Department of Parks
Department of Agriculture
Nature Preserves Commission
Kentucky Heritage Council
Division of Conservation
Department for Natural Resources
Department of Fish and Wildlife Resources
Transportation Cabinet, Department for Military Affairs

Tennessee Technological University
United States Fish and Wildlife Service, Kentucky Field Office in Frankfort, Kentucky
United States Army Corps of Engineers

PUBLIC INVOLVEMENT

The Draft Environmental Assessment was available for public review and comment for a period of thirty days ending on May 30, 2003. A press release was issued announcing the availability of the draft document for public review. The availability of the document was published in newspapers of local and regional circulation. The document was posted on the park Internet site. Hard copies were available on request.

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ATTACHMENTS

1. 7.5 minute topographic maps
2. Section 7, Endangered Species Act compliance
3. Section 106, National Historic Preservation Act compliance
4. Agency Comments
5. Public Comments

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- Cicerello, Ronald R. and Richard R. Hannan. 1990. Survey of the Freshwater Unionids (Mussels) (Bivalvia: Maragraitiferidae and Unionidae) in the Green River in Mammoth Cave National Park, Kentucky. Technical Report prepared for Mammoth Cave National Park, National Park Service, United States Department of the Interior, Mammoth Cave, Kentucky.
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